CLAIM AMENDMENTS

The following is a complete list of claims. The claims below replace all prior versions of the claims in the application. Please cancel claims 10, 11, 23, 25, 29, 30, 34, 35, 37 – 46. Pease amend claims 1 – 9, 15 – 18, 20, 21, 24, 27, 28, 31 – 33 and 36. Please add new claims 47 – 71.

1. (Currently Amended) An apparatus to determine the proximity of a dental instrument ~~in a tooth's root canal~~ to a tooth's ~~the canal's~~ apical foramen while the instrument is in the tooth's canal, ~~while using the dental instrument to perform a dental/medical procedure,~~ the apparatus comprising:

a signal generator coupleable to body tissue of a patient and to a dental instrument that is operable to remove tissue from a tooth of the patient, wherein, while the signal generator is coupled to the body tissue and the instrument, the signal generator ~~operable to~~ generates a voltage signal across the body tissue and the instrument; and ~~a divider signal;~~

a ~~micro~~processor coupleable to the dental instrument and that, while coupled to the dental instrument and while the instrument removes tissue from the patient's tooth, ~~operable to~~

senses the voltage signal after the voltage signal has been modified by the impedance of the patient's body, ~~a stimulation signal derived from the divider signal and modified by a patient's impedance while operating the dental instrument to perform a dental/medical procedure, and operable to sample and~~

demodulates the modified voltage signal to isolate the modified voltage signal ~~stimulation signal~~ from electrical noise generated by the dental instrument, and ~~while operating the dental instrument to perform the dental/medical procedure~~

compares the modified voltage signal to the voltage signal generated by the signal generator.

2. (Currently Amended) The apparatus of claim 1, wherein the voltage signal includes an amplitude and a frequency. ~~dental instrument includes a tip, and the proximity indication includes proximity of the tip to the apical foramen.~~

3. (Currently Amended) The apparatus of claim 1, wherein:

the voltage signal has an amplitude and a frequency, and

the processor compares the amplitude of the voltage signal generated by the signal generator to the amplitude of the modified voltage signal.

~~the apparatus operating the dental instrument is a component of a handpiece.~~

4. (Currently Amended) The apparatus of claim 1, further comprising a reference impedance coupled to the signal generator and the dental instrument such that the reference impedance and the dental instrument are arranged in series relative to each other, and the signal generator generates a voltage signal across the combination of reference impedance, the dental instrument and the body tissue, wherein the reference impedance is known. ~~wherein the microprocessor is operable to compare the divider and the stimulation signal, and generate a proximity signal in response to the comparison from a correlation parameter that includes a lookup table~~.

5. (Currently Amended) The apparatus of claim 1, wherein in response to comparing the modified voltage signal to the voltage signal generated by the signal generator, the ~~micro~~processor ~~is operable to compare the divider and the stimulation signal, and~~ generates a proximity signal ~~in response to the comparison~~ that represents the proximity of the dental instrument to the tooth's apical foramen. ~~from a correlation parameter that includes an equation.~~

6. (Currently Amended) The apparatus of claim 1, further comprising ~~including~~ an analog-to-digital converter that digitizes the modified voltage signal. ~~stimulation signal.~~

7. (Currently Amended) The apparatus of claim 1, wherein:

the voltage signal has an amplitude and a frequency, and

the processor determines the phase of the modified voltage signal relative to the voltage signal generated by the signal generator. ~~further~~

~~including an analog demodulator operable to demodulate the stimulation signal with respect to the divider signal prior to the stimulation signal being sampled.~~

8. (Currently Amended) An apparatus to indicate the proximity of a dental instrument to ~~in~~ a tooth's apical foramen while the instrument is in the tooth's root canal, ~~to the canal's apical foramen,~~ the apparatus comprising:

a first lead operable to couple the apparatus to a dental instrument, and including a second node;

a second lead operable to couple the apparatus to body tissue of a patient and including a third node, wherein the body tissue has an impedance;

a known reference impedance coupled to the first lead such that while the first lead is coupled to the dental instrument and the second lead is coupled to the body tissue, the reference impedance, instrument, and body tissue are arranged in series relative to each other;

a signal generator coupled to the reference impedance and the second lead, wherein the coupling between the signal generator and the reference impedance includes a first node, the signal generator operable to generate a divider signal across the combination of the reference impedance, dental instrument, and body tissue, and wherein the reference impedance is operable to modify the divider signal;

~~a signal generator that provides a divider signal across a first node and a third node;~~

~~a reference impedance coupled between the first node and a second node;~~

~~the second node and third node being configured for electrically coupling between the dental instrument and an electrode coupled with a body tissue of the patient, a stimulation signal being defined across the second node and the third node;~~

a ~~micro~~processor that includes a storage, is coupled to the second node, and that, while the first lead is coupled to the dental instrument, the second lead is coupled to the body tissue, and the instrument removes

tissue from the patient's tooth, the processor ~~the microprocessor being operable to:~~

samples and demodulates a ~~the~~ stimulation signal that includes the divider signal modified by the reference impedance and the body tissue's impedance, and that includes electrical noise generated by the dental instrument;

compares the demodulated stimulation signal to ~~and~~ the divider signal;

stores at least one lookup table that correlates at least one signal comparison ~~of the divider signal and the stimulation signal~~ with a proximity of the dental instrument ~~in a root canal~~ to the apical foramen; and

generates a proximity signal from the lookup table ~~in response to the comparison of the demodulated stimulation signal and the divider signal~~; and

a proximity indicator that indicates the ~~a~~ proximity of the dental instrument to the tooth's apical foramen. ~~in response to the proximity signal.~~

9. (Currently Amended) The apparatus of claim 8, wherein the divider signal includes an amplitude and a frequency. ~~the dental instrument includes a tip, and the proximity indication includes proximity of the tip to the apical foramen.~~

10. – 11. Cancelled

12. (Original) The apparatus of claim 8, wherein the reference impedance essentially consists of a resistive element.

13. (Original) The apparatus of claim 8, wherein the reference impedance comprises a resistive element and a reactive element.

14. (Original) The apparatus of claim 8, further including a signal conditioner.

15. (Currently Amended) The apparatus of claim 14, wherein the signal conditioner includes a low-pass noise filter coupled between the second node and the ~~micro~~processor.

16. (Currently Amended) The apparatus of claim 14, wherein the signal conditioner includes an amplifier coupled between the second node and the ~~micro~~processor.

17. (Currently Amended) The apparatus of claim 8, wherein the processor performs ~~the demodulation of the stimulation signal includes application of~~ at least one of the following: a synchronous demodulation algorithm, a fast Fourier transform, a single frequency fast Fourier transform, and a convolving algorithm, to demodulate the stimulation signal from electrical noise generated by the dental instrument.

18. (Currently Amended) The apparatus of claim 8, wherein the lookup table includes an empirical element derived from observation of the divider signal and the stimulation signal as a function of proximity of the dental instrument ~~in a root canal~~ to the apical foramen in teeth other than teeth of the patient.

19. (Original) The apparatus of claim 8, wherein the proximity indicator includes a digital display.

20. (Currently Amended) The apparatus of claim 19, ~~8,~~ wherein the digital display displays digits representing a relative proximity to the apical foramen.

21. (Currently Amended) The apparatus of claim 19, ~~8,~~ wherein the digital display displays digits representing a distance to the apical foramen in a unit-of-measure.

22. (Original) The apparatus of claim 8, wherein the proximity indicator includes a haptic device.

23. Cancelled

24. (Currently Amended) The apparatus of claim 8, wherein the ~~micro~~processor ~~further includes an operability that automatically~~ updates the proximity signal.

25. Cancelled

26. (Original) The apparatus of claim 8, wherein the divider signal consists essentially of a single frequency.

27. (Currently Amended) A method for indicating the proximity of a dental instrument to ~~in~~ a tooth's ~~root canal to the canal's~~ apical foramen, the method comprising:

generating a divider ~~current~~ signal across a combination of a reference impedance, a dental instrument disposed in the tooth's root canal, and body tissue of a patient, wherein the combination includes the reference impedance, the instrument and the body tissue arranged in series relative to each other; ~~first node and a third node;~~

impeding the signal ~~current~~ with the ~~a~~ reference impedance; ~~coupled between the first node and a second node;~~

further impeding the signal with the body tissue; ~~current by electrically coupling the dental instrument in the root canal and an electrode coupled with a body tissue of the patient between the second node and third node, a stimulation signal being defined between the second node and the third node;~~

sampling and demodulating a ~~the~~ stimulation signal that includes the divider signal modified by the body tissue's impedance, and that includes electrical noise generated by the dental instrument as the instrument operates;

~~digitally~~ comparing the demodulated stimulation signal to ~~and~~ the divider signal

based on the comparison, ~~and~~ generating a proximity signal; and ~~from a stored lookup table in response to the comparison, the lookup table correlating at least one comparison of the divider signal and the stimulation signal with a proximity of the dental instrument in a root canal to the apical foramen; and~~

based on the proximity signal, indicating a proximity of the dental instrument to the apical foramen. ~~in response to the proximity signal.~~

28. (Currently Amended) The method ~~apparatus~~ of claim 27, wherein generating the divider signal includes generating a signal that includes an amplitude and a frequency. ~~the dental instrument includes a tip, and the proximity indication includes proximity of the tip to the apical foramen.~~

29. – 30. Cancelled

31. (Currently Amended) The method of claim 27, ~~29,~~ wherein demodulating the stimulation signal includes filtering noise from the stimulation signal. ~~including~~

~~a further step of digitally processing only frequencies extending from zero up to a cutoff frequency above the stimulation signal frequency.~~

32. (Currently Amended) The method of claim 27, ~~29,~~ wherein sampling the stimulation signal includes ~~ing a further step of~~ amplifying the stimulation signal. ~~before digitally processing the stimulation signal.~~

33. (Currently Amended) The method of claim 27, ~~29,~~ wherein indicating the proximity of the dental instrument to the apical foramen includes ~~including a further step of automatically~~ updating the proximity signal.

34. – 35. Cancelled

36. The method of claim 27, ~~34,~~ wherein the divider signal consists essentially of a single frequency.

37. – 46. Cancelled

47. (New) The apparatus of claim 5 wherein the proximity signal is generated from a look-up table that is stored in the apparatus.

48. (New) The apparatus of claim 5 wherein the proximity signal is generated from an equation that is stored in the apparatus and executed by the processor.

49. (New) The apparatus of claim 1 wherein the processor executes a synchronous demodulation algorithm to demodulate the modified voltage signal from electrical noise generated by the dental instrument.

50. (New) The apparatus of claim 1 wherein the processor performs a fast Fourier transform of the modified voltage signal to demodulate the modified voltage signal from electrical noise generated by the dental instrument.

51. (New) The apparatus of claim 1 wherein the processor performs a single-frequency fast Fourier transform of the modified voltage signal to demodulate the modified voltage signal from electrical noise generated by the dental instrument.

52. (New) The apparatus of claim 1 wherein the processor executes a convolving algorithm to demodulate the modified voltage signal from electrical noise generated by the dental instrument.

53. (New) The method of claim 27 wherein the reference impedance includes a resistive element.

54. (New) The method of claim 27 wherein the reference impedance includes a reactive element.

55. (New) The method of claim 27 wherein demodulating the stimulation signal includes performing at least one of the following: a synchronous demodulation algorithm, a fast Fourier transform, a single frequency fast Fourier transform, and a convolving algorithm.

56. (New) The method of claim 27 wherein generating a proximity signal includes retrieving data from a lookup table that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

57. (New) The method of claim 27 wherein generating a proximity signal includes executing an equation that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

58. (New) A method for indicating the proximity of a dental instrument to a tooth's apical foramen, the method comprising:

generating a voltage signal across a combination of a dental instrument disposed in the tooth's root canal, and body tissue of a patient, wherein the combination includes the instrument and the body tissue arranged in series relative to each other;

impeding the signal with the body tissue;

while the dental instrument removes tissue from the tooth, sensing the voltage signal after the voltage signal has been modified by the impedance of the patient's body tissue;

demodulating the modified voltage signal to isolate the modified voltage signal from electrical noise generated by the dental instrument; and

comparing the modified voltage signal to the generated voltage signal.

59. (New) The method of claim 58, wherein generating the voltage signal includes generating a signal that includes an amplitude and a frequency.

60. (New) The method of claim 58, wherein the voltage signal consists essentially of a single frequency.

61. (New) The method of claim 59 wherein comparing the modified voltage signal to the generated voltage signal includes comparing their amplitudes.

62. (New) The method of claim 59 wherein comparing the modified voltage signal to the generated voltage signal includes comparing the phase of the modified voltage signal relative to the phase of the generated voltage signal.

63. (New) The method of claim 59 wherein comparing the modified voltage signal to the generated voltage signal includes comparing their amplitudes and the phase of the modified voltage signal relative to the phase of the generated voltage signal.

64. (New) The method of claim 58, wherein sensing the modified voltage signal includes amplifying the modified voltage signal.

65. (New) The method of claim 58, wherein demodulating the modified voltage signal includes filtering noise from the modified voltage signal.

66. (New) The method of claim 58 wherein demodulating the modified voltage signal includes performing at least one of the following: a synchronous demodulation algorithm, a fast Fourier transform, a single frequency fast Fourier transform, and a convolving algorithm.

67. (New) The method of claim 58 further comprising generating a proximity signal based on the signal comparison.

68. (New) The method of claim 67 further comprising indicating a proximity of the dental instrument to the apical foramen based on the proximity signal.

69. (New) The method of claim 67 wherein generating a proximity signal includes retrieving data from a lookup table that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

70. (New) The method of claim 67 wherein generating a proximity signal includes executing an equation that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

71. (New) The method of claim 67, wherein indicating the proximity of the dental instrument to the apical foramen includes updating the proximity signal.